LOW COST COURSE CORRECTION (LCCC) FOR THE M261 HYDRA-70 ROCKET

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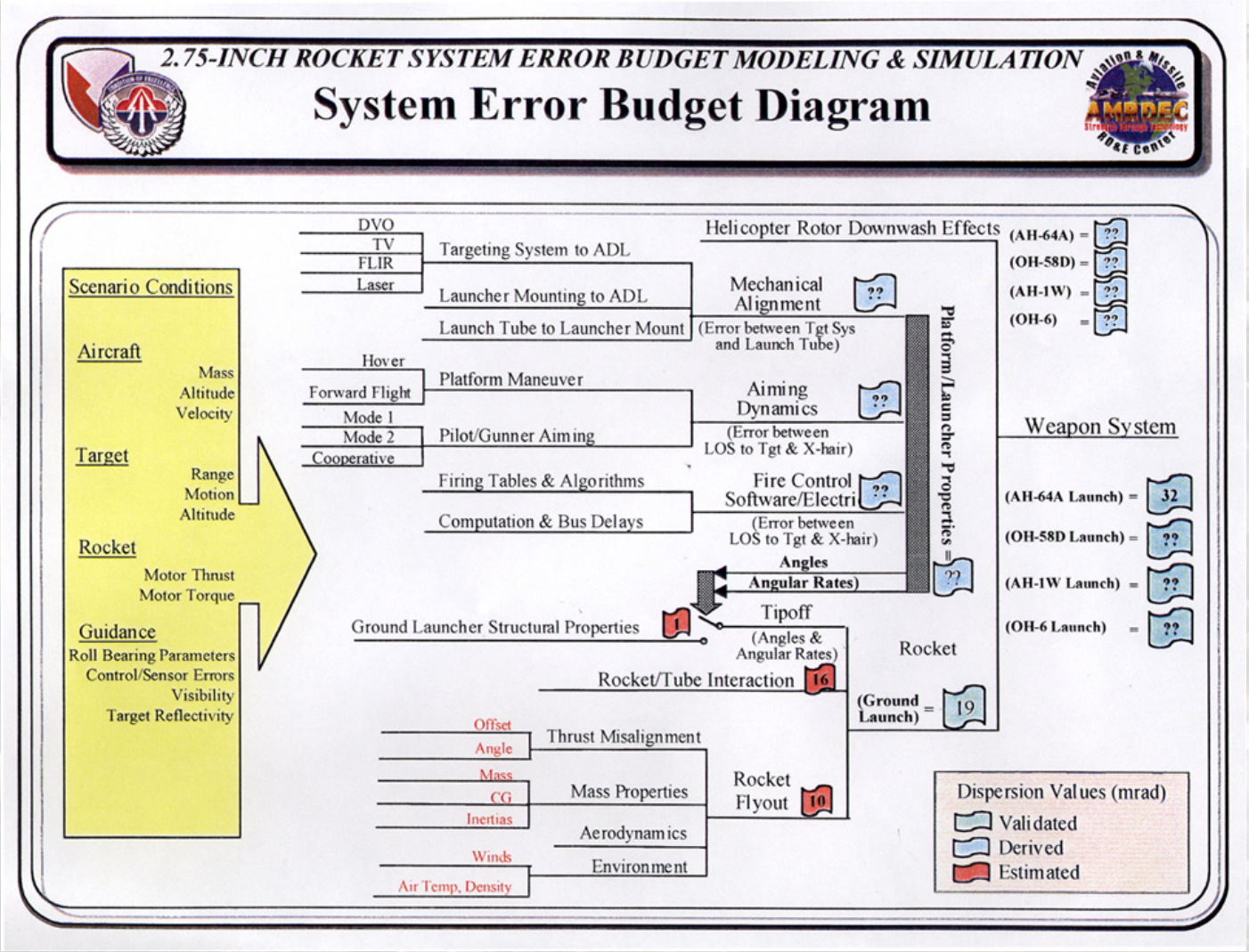
Overview

- U.S. Army ARDEC sponsored a study to investigate the feasibility of incorporating Low Cost Course Correction Seeker onto M261, MPSM Rocket
- GD-OTS in conjunction with TG&C Associates and GD-AIS completed study in 2001
- Study Included:
  - M261 LCCC Nose Module Design
  - Aerodynamic Study Results
  - Accuracy Improvement Estimates
  - ARDEC Effectiveness Analysis
- Short range flight testing completed on related LCCC program



24 mrad Systems Error Estimated for M261 Rocket due to Rocket and Platform Induced Errors

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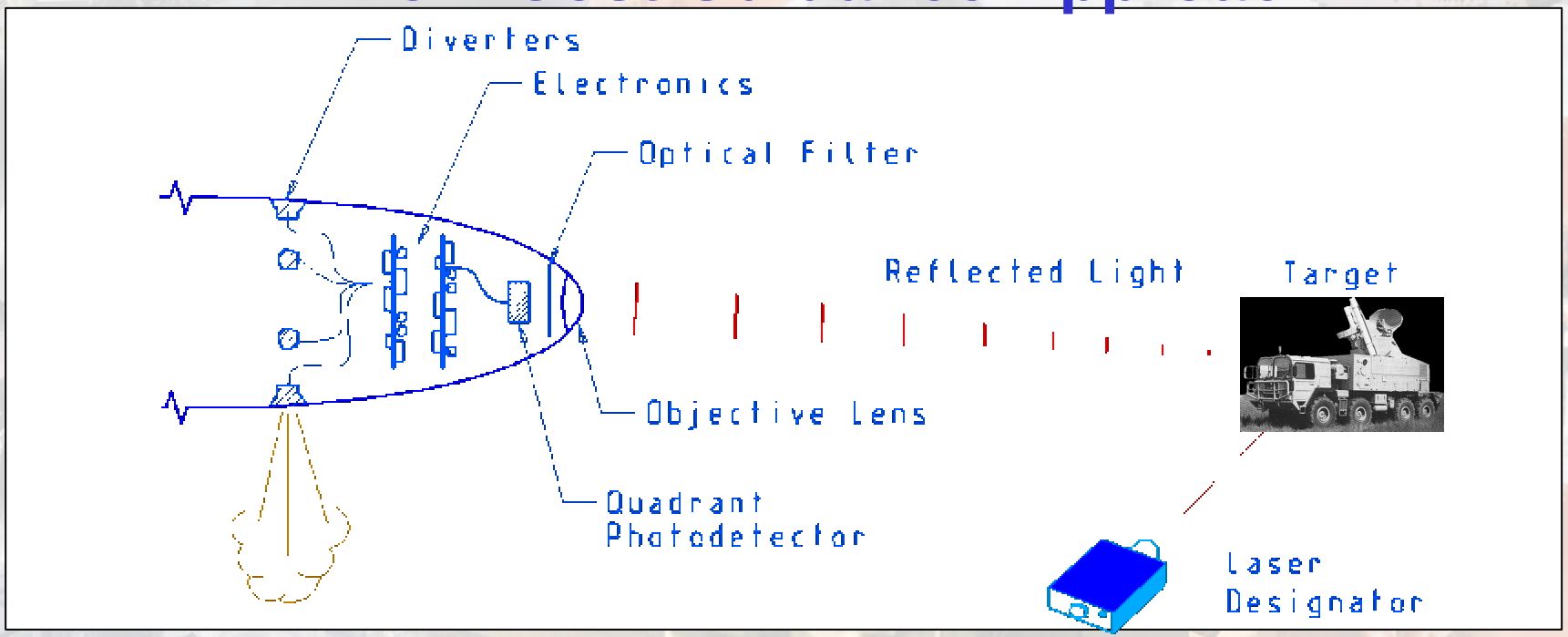
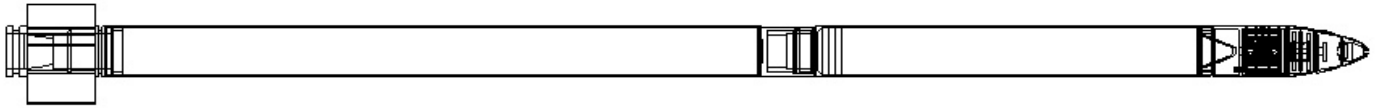
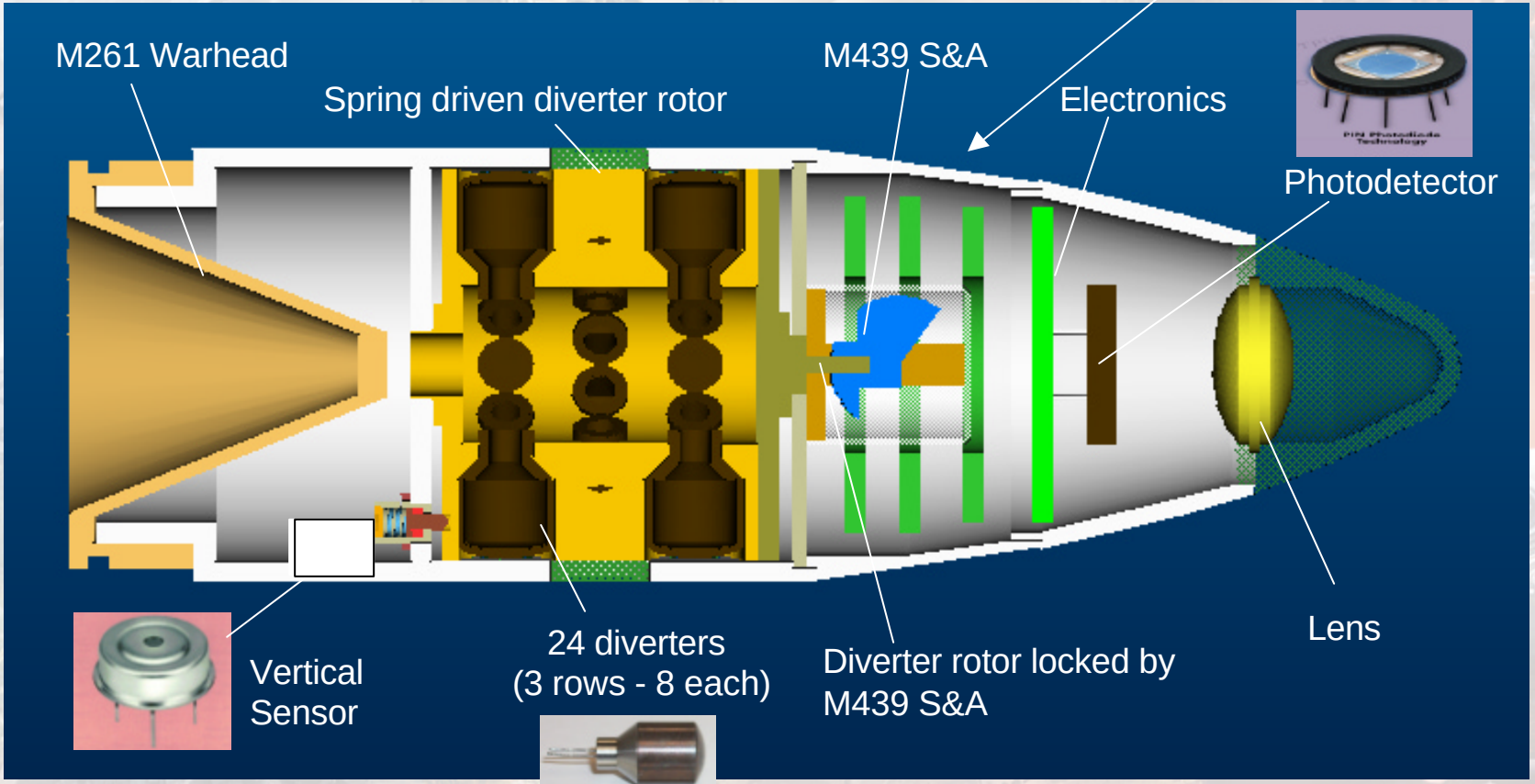
Low-Cost Guidance Approach



- Body fixed guidance approach eliminates system errors to make ammunition much more accurate and effective
- Semi-active laser guidance with micro explosive diverter control system
- Eliminates need for expensive rate sensors and gyros
- Unnecessary to train and develop complex algorithms
- Off the shelf electronic components

M261 2.75” LCCC TACTICAL MODULE DESIGN





LCCC NOSE MODULE CAN BE USED ON EXISTING M261 ROCKETS

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M261 Aerodynamic Study Parameters

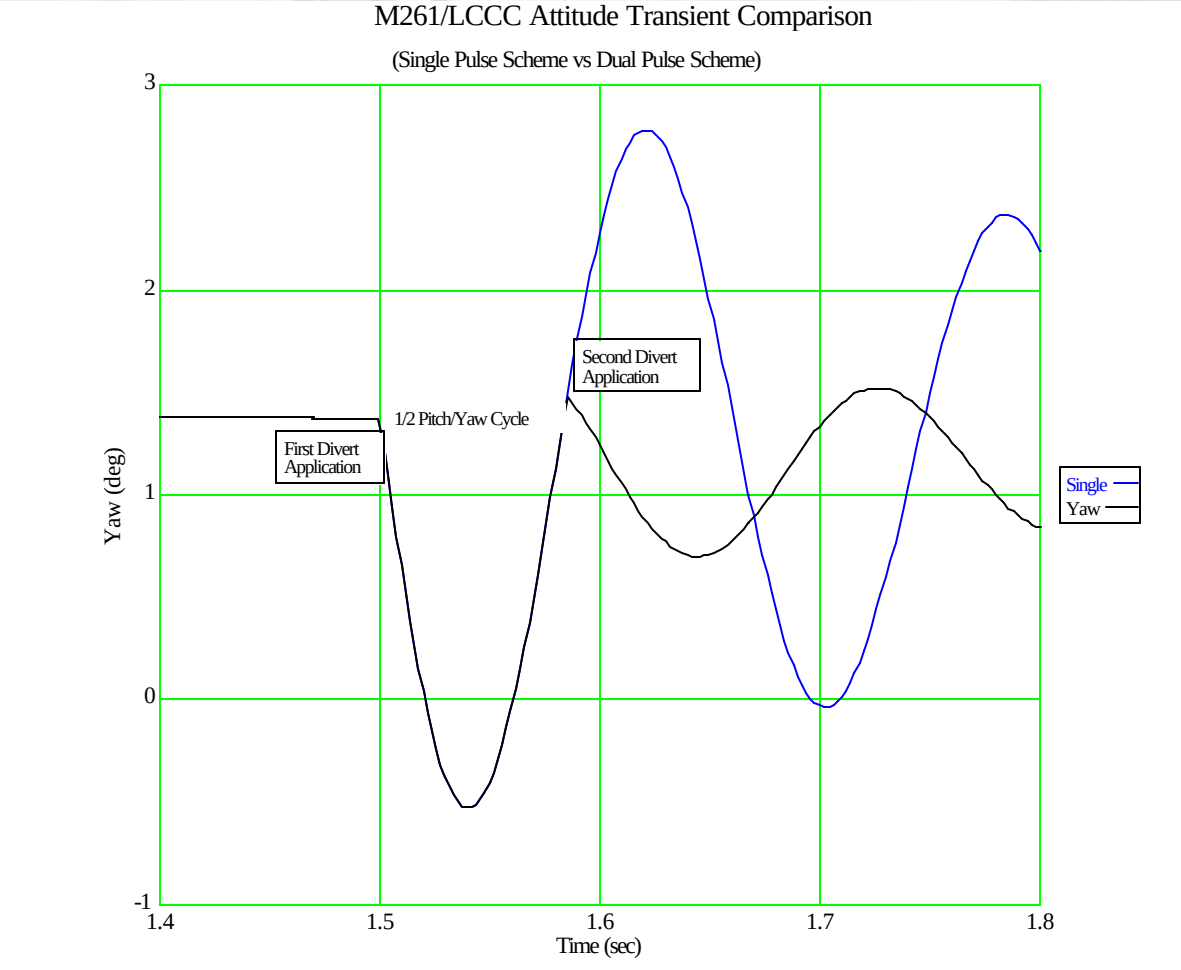
- LCCC System Simulation Parameters

Parameter	Value
Impulse	2.6 N-s
Pulse Duration	0.5 msec
No. of Diverters	32 (2 rows of 16 diverters)
Divert Axial Location	0.6825 m (fwd of initial CG location)
Phase Angle Tolerance	1.0 Deg
Azimuth Error (@launch)	24 mrad
Launch Altitude	10 m
Mass Properties	M261 Round

  - All performance evaluation based on a target located on the ground 2-6km downrange of the launch point.

Control Algorithm Definition/Selection

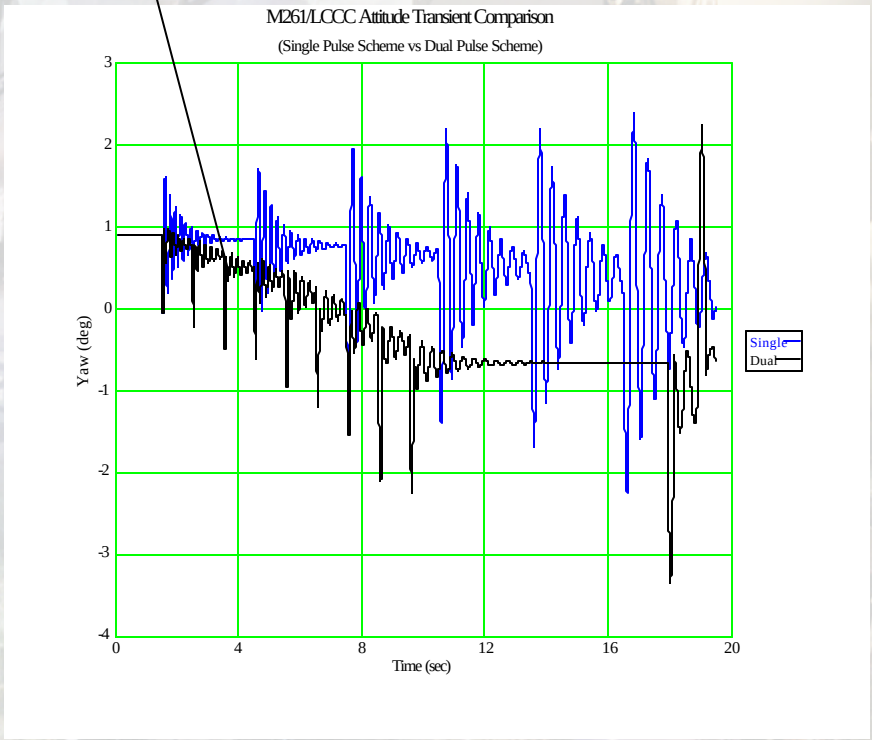
- Dual Pulse Control Law Approach

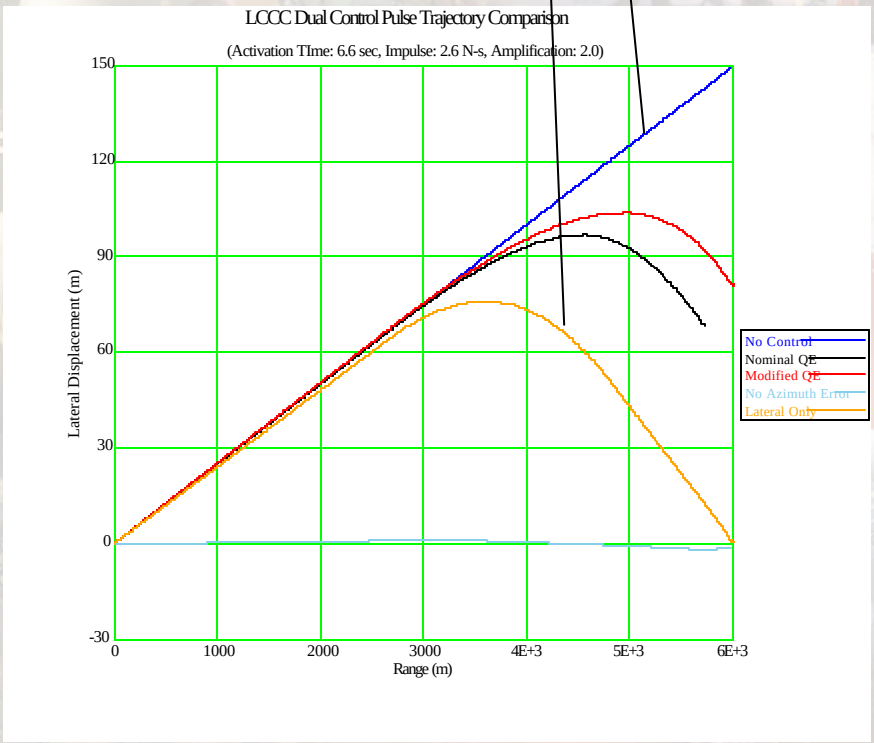


2.75” Modeling Results
6 KM

Dual Divert Provided Best Accuracy Improvement for 2.75” Rocket

11 Pairs of 2.6 N-Sec Diverters provides 0.5 mrad accuracy compared with 24 mrad baseline





Single vs. Dual Divert Approach

Accuracy Improvement Quantified

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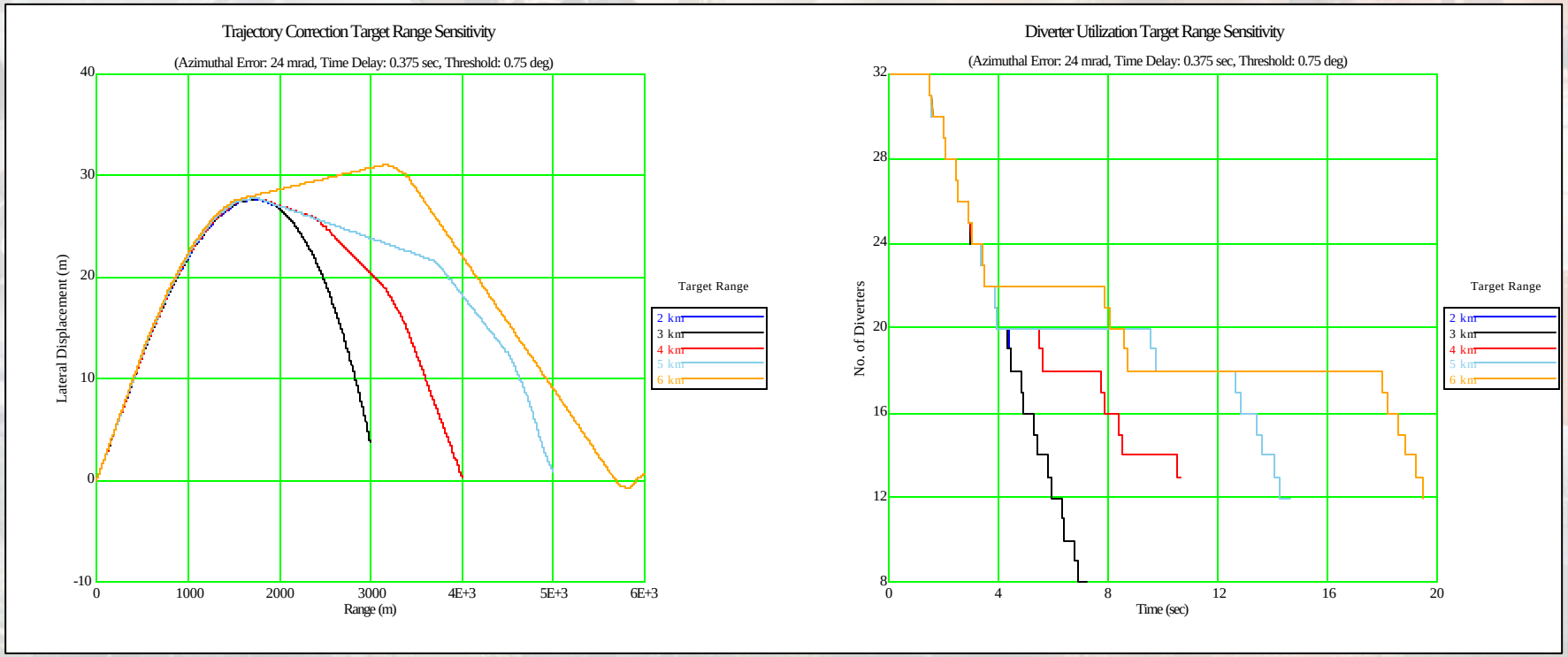
2.75” Modeling Results
2-6 KM

Simulation Results



- Lateral dispersion < 5 m for the range of target locations of 3 km and longer

LCCC M261 Accuracy Improvement

Case 3

11 Pairs 5.2 N-sec diverters
Up/down sensor
(+/- 1 sigma = 6 M)

Case 1

11 Pairs 2.6 N-sec diverters
No Up/down sensor
(+/- 1 sigma = 156 M)

Baseline

No Correction
(+/- 1 sigma = 288 M)

Case 2

11 Pairs 2.6 N-sec diverters
Vertical sensor
(+/- 1 sigma = 12 M)

INITIAL CONDITIONS
Launch Error: 24 mrad

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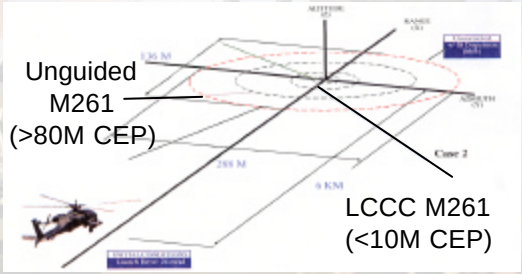
M261 EFFECTIVENESS ANALYSIS

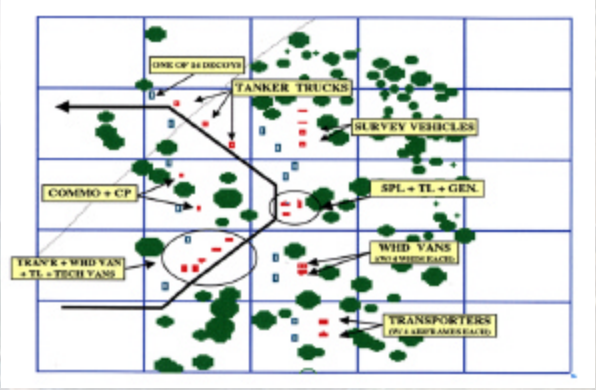
Increased Accuracy



P_{HIT}		
Range	M261	LCCC M261
6 KM	.07	.97

WARFIGHTER BENEFITS

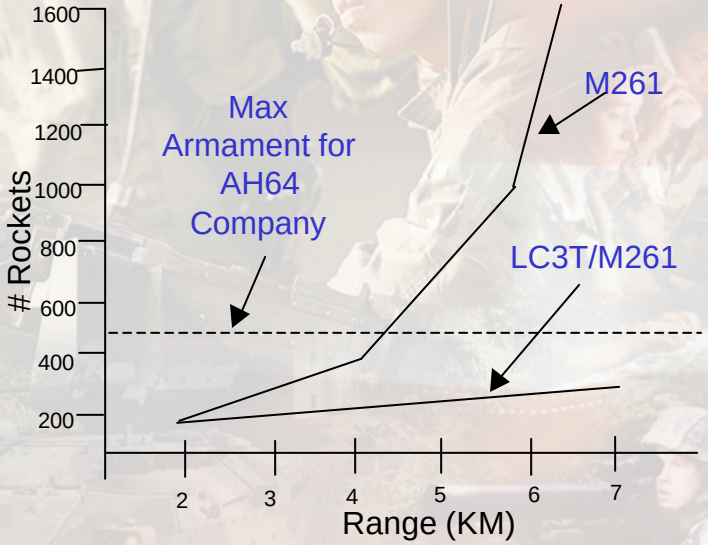
Against Scud Battery



Attack	Helicopter	Weapon	Percent Destruction
(6) AH64	50% Load	M261	.30
			6-10 hr Time delay
(6) AH64	**50% Load**	**LC3T/M261**	**.60**
			48 hr Time delay

Against Dismounted NKPA Motorized Infantry

Rockets Required for 45% Destruction



ARDEC Effectivity Analysis Shows Warfighter Benefits of LCCC M261 Rocket

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Demonstration Testing

Multi-Layered Soft Catch Target

LED Target
(40’ to side of target)

Projectile Soft Catch in Rubber Filled Target

3.5” LCCC Test Projectile

Short Range Testing Demonstrated LCCC Guidance Approach Feasibility

(Acquired Target & Diverted Projectile toward target)

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Summary

- Significant accuracy improvement (from 24 mrad to 1 mrad) appears achievable with body fixed semi-active laser guidance approach
- Dual pulse thruster approach and vertical sensor required for optimum accuracy improvement
- ARDEC effectivity analysis shows great benefit for improved accuracy M261 rocket
- Testing conducted under 2001 ARDEC Tech Base Program has shown feasibility of approach for guiding spinning projectiles
- Hardware in the Loop and Flight testing required to quantify accuracy improvement achievable with LCCC